



## Proposed Plan for Operable Unit 7-08

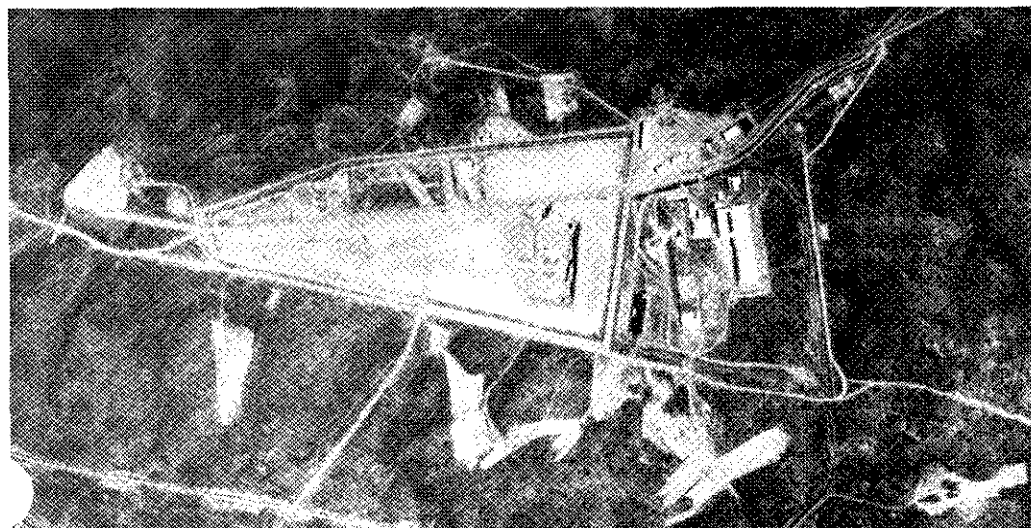


STATE OF IDAHO  
DEPARTMENT OF HEALTH AND WELFARE  
DIVISION OF ENVIRONMENTAL QUALITY

# Organic Contamination in the Vadose Zone

## Radioactive Waste Management Complex, Idaho National Engineering Laboratory

**Public Comment Period - March 31 to April 30, 1994**



*Photo of area impacted by organic contamination in the vadose zone.*

(Editors Note: Technical and administrative terms are used throughout this Proposed Plan. When these terms are first used, they are printed in ***bold italics***. Explanations of these terms, document references, and other helpful notes are provided in the margins.)

### Introduction

The purpose of this ***Proposed Plan*** is to summarize information and seek comments on remedial action alternatives proposed for the organic contamination found in the ***vadose zone*** soils and basalt beneath and within the immediate vicinity of the Radioactive Waste Management Complex (RWMC). The area of contamination is referred to as the Organic Contamination in the Vadose Zone (Operable Unit 7-08): an area contaminated with non-radioactive ***volatile organic compounds*** that have vaporized and migrated into the vadose zone from buried organic wastes (i.e., solvents and industrial degreasers) in the Subsurface Disposal Area of the RWMC. The primary reason for this investigation was the concern that these organic vapors in the vadose zone could adversely impact human health and the environment. As shown in Figure 1, the RWMC is located in the southwest portion of the Idaho National Engineering Laboratory (INEL).

### Impact to the Underlying Aquifer

Organic vapors within the vadose zone are moving downward to the Snake River Plain aquifer. A small quantity of contaminants has already reached the aquifer in concentrations that are lower than the state of Idaho safe drinking water standards. A smaller amount of the vadose zone vapors is currently moving upward to the atmosphere. (See

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### Mall/Office Sessions\*

**Pocatello** - Pine Ridge Mall  
Tuesday, April 12

**Twin Falls** - INEL Regional Office  
Thursday, April 14

### Sessions with Public Meetings\*

**Idaho Falls** - Grand Teton Mall  
Monday, April 18

**Boise** - Boise Centre on the Grove  
Wednesday, April 20

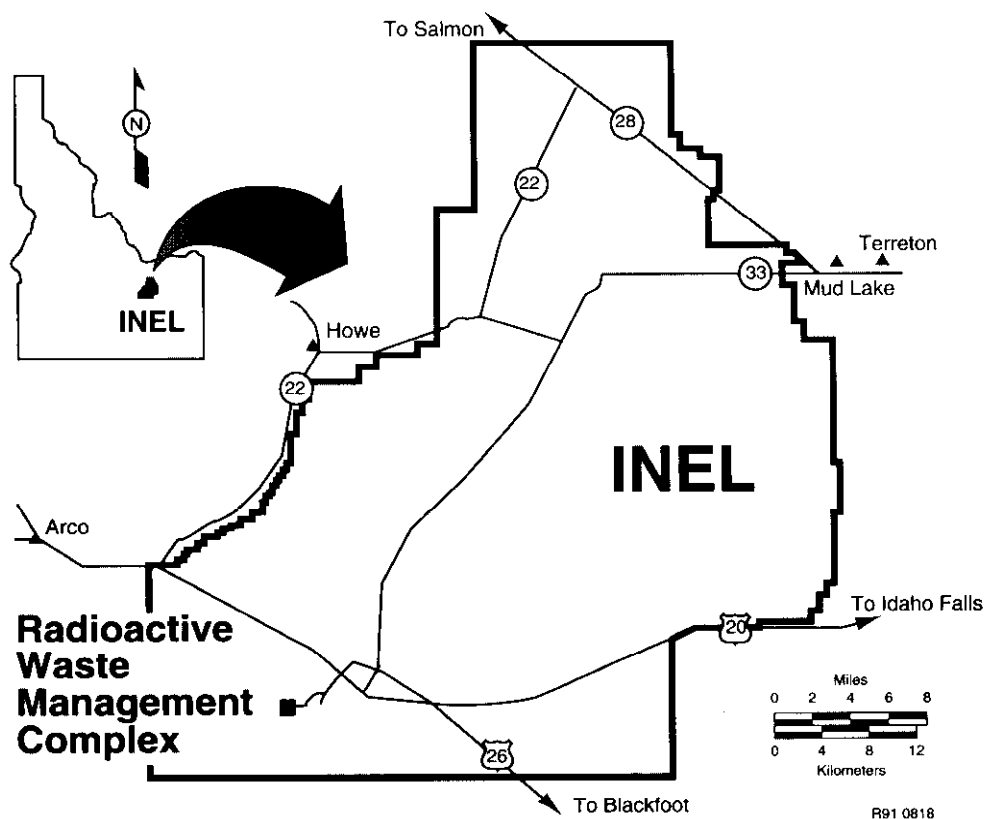
**Moscow** - Palouse Empire Mall  
Thursday, April 21

\* See page 18 for details.

**Proposed Plan** - document requesting public input on a proposed remedial alternative (cleanup plan).

**vadose zone** - a region extending from the ground surface to the top of the groundwater table (i.e., Snake River Plain Aquifer) approximately 580 feet thick beneath the RWMC (see Figure 3).

**volatile organic compounds** - a group of organic compounds that have a tendency to vaporize readily. (Examples: carbon tetrachloride, trichloroethylene, benzene, and methane.)



**Figure 1.** Location of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory.

discussion in Section 5 of the Administrative Record document *Remedial Investigation/Feasibility Study for Organic Contamination in the Vadose Zone - Operable Unit 7-08*, (EGG-ER-10684), pages 5-60 and 5-74.)

### Agency Involvement

The U.S. Department of Energy Idaho Operations Office (DOE), U.S. Environmental Protection Agency Region 10 (EPA), and the Idaho Department of Health and Welfare (IDHW) prepared this plan in accordance with public participation requirements identified under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA**), commonly called Superfund. Note that hereinafter, the DOE, EPA, and IDHW will be referred to as "the agencies."

This plan outlines the results of the Organic Contamination in the Vadose Zone Remedial Investigation, including the potential risk to human health; summarizes the remedial action alternatives considered in the Feasibility Study; and discusses the selection of a preferred alternative. The information summarized in this plan can be found in greater detail in the report titled *Remedial Investigation/Feasibility Study for Organic Contamination in the Vadose Zone - Operable Unit 7-08*. This document and other supporting information are available in the **Administrative Record**, which may be reviewed at the INEL Information Repositories listed on page 14.

### Recommended Alternative

The recommended remedial action alternative for organic contamination in the vadose zone is Extraction/Treatment by **Vapor Vacuum Extraction (VVE)**. Other alternatives considered included No Action (required by law to be evaluated); Containment of Vadose Zone Contaminants by Capping; Extraction/Treatment by VVE with Vaporization Enhancement; and In Situ Bioremediation. Extraction/Treatment by VVE is

**Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)** - A federal law (also known as "Superfund") that provides a comprehensive framework to deal with past or abandoned hazardous materials.

**Administrative Record** - documents including correspondence, public comments, Record of Decision, and technical reports upon which the agencies base their remedial action selection.

**vapor vacuum extraction (VVE)** - a technology developed to extract vapor from beneath the ground by inducing a vacuum in wells located at specific depths. The vacuum forces underground vapors to flow towards the well and up into an aboveground treatment system.

recommended because it is believed to provide the best balance of trade-offs among the alternatives. This alternative would be designed to be protective of human health and the environment and to comply with federal and state regulations. All alternatives are explained in detail in the section entitled Summary of Alternatives (see page 10).

There is an existing VVE system that was installed in 1989 to test the viability of VVE to recover vaporized organic contaminants from the vadose zone. Under the preferred alternative, this existing VVE system would be expanded through the installation of five additional vapor extraction wells. All vapor extraction wells would be designed so that extracted, contaminated vapors would be contained and directed to a vapor treatment system.

## Community Acceptance

Community acceptance is one of the criteria the agencies must evaluate during the process of selecting a remedy. The only way the agencies have to gauge the degree of community acceptance is to 1) open dialogue with citizens concerning the results of the investigation, and 2) encourage citizens to participate by commenting on the remedial alternatives for the Organic Contamination in the Vadose Zone project. This interaction is critical to the CERCLA process and to making sound environmental decisions.

Although this plan identifies Extraction/Treatment by Vapor Vacuum Extraction as the agencies' preferred alternative, the public is encouraged to review and comment on all the alternatives, not just the preferred alternative. Details on the alternatives developed for this project can be found in Volume III, Section 3, of the *Remedial Investigation/Feasibility Study for Organic Contamination in the Vadose Zone - Operable Unit 7-08*, (pages 3-1 to 3-28). Additional information supporting the recommended remedial action is available for review in the Administrative Record file for this project at the INEL Information Repositories listed on page 14.

The actual selection of an alternative cannot be made until after comments received during the public comment period have been reviewed and analyzed. The agencies will consider all public comments on this proposed plan in preparing the **Record of Decision**. Depending on comments received, the final remedial action plan presented in the Record of Decision could be different from the preferred alternative. All written and verbal comments will be summarized and responded to in the **Responsiveness Summary** section of the Record of Decision, which is scheduled to be completed by October 1994.

## Site Background

The INEL is an 890-square-mile DOE facility on the Eastern Snake River Plain in southeastern Idaho whose primary mission is nuclear reactor technology development and waste management. The Eastern Snake River Plain is a relatively flat, semi-arid sagebrush desert. The plain is bounded on the north and west by the Lost River, Lemhi, and Bitterroot Mountain ranges. Drainages around and within the Eastern Snake River Plain recharge the Snake River Plain Aquifer. The top of the aquifer is about 580 feet below the RWMC and occurs in and is overlain by basaltic lava flows with thicknesses up to several thousands of feet. Within the flows are thin layers of sediment called **interbeds**. The 110-foot and 240-foot interbeds beneath the Subsurface Disposal Area are generally less permeable than the surrounding fractured basalt.

Due to confirmed contaminant releases to the environment, in November 1989 the INEL was placed on the **National Priorities List**, which identifies hazardous substance sites requiring investigation. Under CERCLA, the risks posed by hazardous sub-

## How You Can Participate

Whether you are new to the INEL and are reading this type of document for the first time, or you are familiar with the Superfund process, you are invited to:

- **Read** this proposed plan and review additional documents in the Administrative Record file
- **Call** a regional INEL office (see page 14) to ask questions, request information, or make arrangements for a briefing
- **Attend** a public meeting or mall display session listed on page 18 and give verbal comments
- **Submit** written comments (see postage-paid comment form on back cover) by April 30, 1994
- **Contact** state of Idaho or EPA Region 10 project managers (see pages 15 and 17)

## More INEL Information

The 1994 INEL Site-Specific Plan (230 pages) and a summary of the plan (36 pages) contain information on INEL's mission, and highlight the major programs of environmental restoration, waste management, and opportunities for public involvement. Call one of the phone numbers on page 14 to request a copy of the plan or summary, or visit an INEL Information Repository to review them in binder 400.

**Record of Decision** - a public record documenting the final determination of the selected alternative. Records of Decision follow the consideration of public comment, and apply to both CERCLA and the National Environmental Policy Act; INEL CERCLA decisions are signed by the Regional Administrator of EPA Region 10, DOE, and the state of Idaho.

**Responsiveness Summary** - the part of the Record of Decision which summarizes and provides responses to comments received on a proposed action for a site during the public comment period.

**interbeds** - sedimentary deposits located between basalt layers in the subsurface. Characterized by densely packed sandy and clayey soils. Interbeds tend to inhibit downward migration of contaminants as they are generally less permeable than basalt.

**National Priorities List** - a formal listing of the nation's worst hazardous waste sites as established by CERCLA that have been identified for possible remediation. Sites are ranked by the EPA based on their potential for affecting human health and the environment.

**remedial investigation** - identifies the nature and extent of contamination at a site. Also provides an assessment of the potential risks associated with a site.

**feasibility study** - provides a full analysis of cleanup alternatives based on information gathered during the remedial investigation.

**disposal pit** - pits and trenches located at the Subsurface Disposal Area. Contain buried wastes which are covered with soil.

**transuranic** - any radionuclide with an atomic number greater than that of uranium (92).

stances at National Priorities List sites must be evaluated and, if necessary, appropriate remediation methods must be implemented to reduce risks to acceptable levels.

The investigation was implemented under a Federal Facility Agreement and Consent Order which was signed by the agencies in December 1991. A **Remedial Investigation/Feasibility Study** and any required cleanup of specific operable units at the INEL are guided by the Federal Facility Agreement and Consent Order and its associated Action Plan. These documents, negotiated by the agencies, provide procedures and schedules to ensure investigations are conducted in compliance with federal and state environmental laws.

To better manage investigations of potentially contaminated sites, the INEL has been divided into 10 Waste Area Groups (WAGs). Each WAG has been divided into operable units to expedite the investigations associated with remedial activities. Under this management system, WAG 7 covers the RWMC. Organic Contamination in the Vadose Zone has been designated as Operable Unit 8 of WAG 7 and, thus, is referred to as Operable Unit 7-08. This operable unit consists of the vadose zone beneath and within the immediate vicinity of the RWMC.

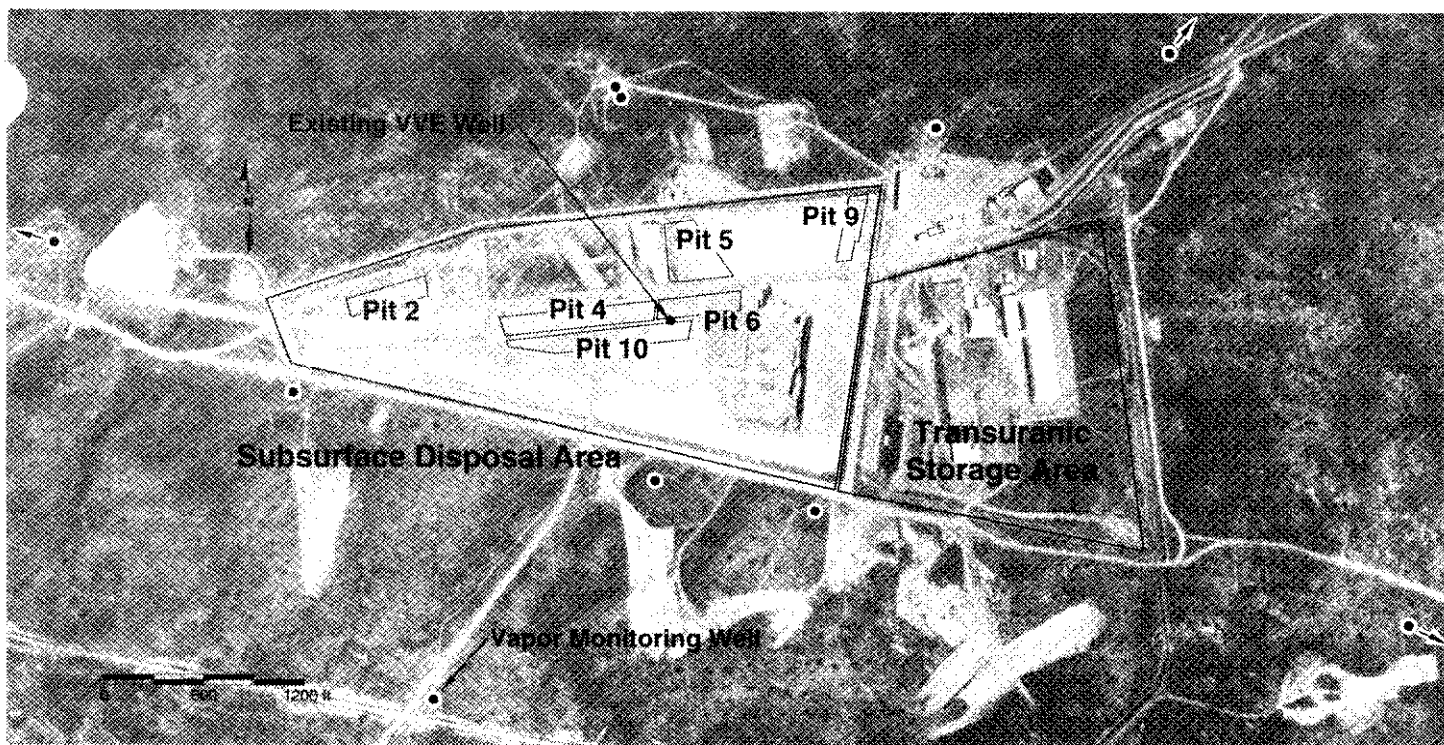
In 1991, the agencies initiated a remedial investigation/feasibility study to determine if the organic contamination in the vadose zone underlying the RWMC could adversely impact human health and the environment. Buried organic wastes remaining in **disposal pits** (i.e., pits and trenches) of the Subsurface Disposal Area were not addressed as part of this investigation. **Transuranic** and nontransuranic contaminated disposal pits are scheduled to be investigated under Operable Units 7-03 and 7-13, respectively. Remedial investigations and feasibility studies are scheduled to begin in 1994 for these operable units.

Groundwater beneath and within the immediate vicinity of the RWMC is being investigated as part of Operable Unit 7-06. The entire RWMC will be evaluated in the WAG 7 comprehensive remedial investigation and feasibility study scheduled to begin in 1996.

### **Organic Contamination in the Vadose Zone Description**

The Organic Contamination in the Vadose Zone operable unit is defined as that part of the vadose zone beneath and within the immediate vicinity of the RWMC where there are organic contaminants in a vapor state. As such, the operable unit extends from the ground surface to the top of the Snake River Plain Aquifer: approximately 580 feet below land surface. The operable unit does not directly include the disposal pits of the Subsurface Disposal Area. However, these sources of organic contaminant release to the vadose zone have been considered in computer simulations that estimate the transport of contaminants through the environment.

The presence of organic contaminants in the vadose zone is a result of the burial, and presumed breach, at the Subsurface Disposal Area of containerized organic wastes from the Rocky Flats Plant in Colorado. From 1966 to 1970, approximately 88,400 gallons of containerized organic wastes were mixed with calcium silicate to reduce free liquids and form a grease- or paste-like material prior to being sent to the INEL for disposal in several pits at the Subsurface Disposal Area. In addition, small amounts of absorbent, such as Oil-Dri, were normally mixed with the waste to bind free liquids. The organic wastes consisted of lathe coolant (Texaco Regal Oil and carbon tetrachloride), used oils, and degreasing agents such as trichloroethane, trichlorethylene, and tetrachloroethylene. Specific components of the organic wastes were 24,000 gallons of carbon tetrachloride and 25,000 gallons of other chlorinated hydrocarbons. The balance of the 88,400 gallons was primarily Texaco Regal Oil. Pits 4, 5, 6, 9, and 10 have been identified as receiving the organic wastes. The locations of these pits are shown in Figure 2. Also, Pit 2 received an unknown quantity of organic waste before 1966.



**Figure 2.** Location of pits in the Subsurface Disposal Area, where organic vapors originated, and location of vapor monitoring wells.

## Summary of the Remedial Investigation

The remedial investigation for Operable Unit 7-08 included a number of tasks designed to identify the nature and extent of organic contaminants in the vadose zone beneath and within the immediate vicinity of the RWMC. These tasks included soil vapor monitoring, tracer studies, permeability measurements, and sampling of perched water and groundwater. The data obtained during the remedial investigation was used along with the fate and transport modeling to conduct the **baseline risk assessment**.

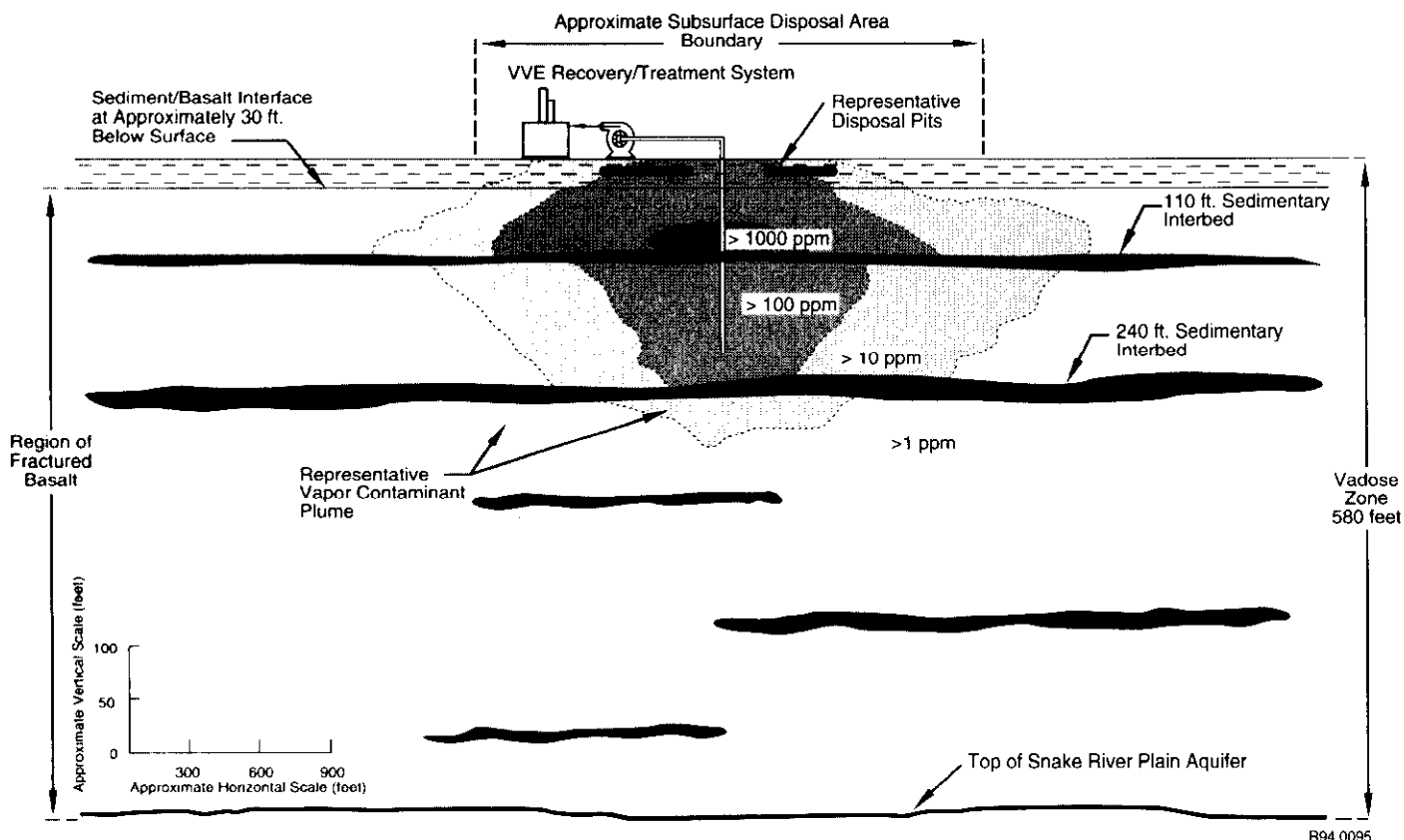
Sampling conducted for the remedial investigation has documented that organic contaminants have migrated from the disposal units into the vadose zone. In the vadose zone, organic contaminants are migrating both vertically (primarily downward) and laterally away from the disposal pits. Vertical migration of contaminants occurs both by vapor diffusion and infiltration of moisture through the vadose zone. Lateral migration occurs primarily by diffusion of organic contaminant vapors. Organic contaminants have been detected in soil vapor, surficial soils, **perched water**, and in the Snake River Plain Aquifer. Concentrations of organic contaminants in the Snake River Plain Aquifer beneath the RWMC are below state drinking water standards (e.g., the state standard for carbon tetrachloride is **5 parts per billion**). Although contaminant concentrations in perched water are higher than in the aquifer, perched water is very limited and is not a viable source of water in the vicinity of the RWMC. (See Administrative Record document *Remedial Investigation/Feasibility Study for Organic Contamination in the Vadose Zone - Operable Unit 7-08*, (Section 3.5.3.2, page 3-77 and Section 4.2.2, page 4-70.)

Carbon tetrachloride is the organic contaminant detected in the highest concentrations in soil vapor in the vadose zone, ranging from several thousand ppm at the 110-foot interbed to 1 ppm near the top of the aquifer. Other compounds such as chloroform and trichloroethylene are also present in vapor, but at concentrations 10 to 100 times

**baseline risk assessment** - an assessment required to be conducted under CERCLA to evaluate potential risks to human health and environment. This assessment estimates risks/hazards associated with existing and/or potential human and environmental exposures to contaminants at an area.

**perched water** - unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone. May be confined within or above a low permeability zone.

**parts per billion (ppb)** - a ratio of mass of contaminant to the total mass of contaminant and medium (usually soil or water). Example: 1 ppb carbon tetrachloride can mean 1 gram of carbon tetrachloride in 1 billion grams of water. Parts per billion of contaminants in water can also be expressed (numerically equivalent) as micrograms per liter.



**Figure 3.** Conceptual cross section of VVE system showing approximate extent of vapor plume.

lower than carbon tetrachloride. Figure 3 is a cross section through the Subsurface Disposal Area showing a conceptual representation of carbon tetrachloride concentrations in subsurface vapor. The highest concentrations of organic contaminants have been detected in soil vapor directly below the Subsurface Disposal Area. Contaminant vapor concentrations tend to decrease with distance both laterally and vertically from the disposal units. The less permeable sedimentary interbeds act to slow the downward migration of contaminants, resulting in lateral spreading of the vapor plume. This spreading is illustrated by the shape of the plume, especially at the 110-foot interbed.

Although organic contaminants have been detected in soil vapor near the top of the Snake River Plain Aquifer, the vast majority of organic contaminants are in the upper portion of the vadose zone above the 240-foot interbed. The investigation shows these organic contaminants will continue to migrate downward to the Snake River Plain Aquifer.

#### **Treatability Study**

To collect information for the remedial investigation, a small scale vapor vacuum extraction system was operated for approximately 1670 hours during the summer of 1993. During the operation 2930 pounds (1338 kilograms) of volatile organic compounds were removed from the vadose zone. Once the vapors were extracted 110 feet (33.5 meters) from the vadose zone to the surface, they were collected through the use of carbon adsorbers.

Prior to the 1993 test, the vapor vacuum extraction system was operated at the RWMC in 1989 and in 1990. During a two-week test, 8.9 million cubic feet (267,000 cubic meters) of vadose zone vapors were removed. During a four-month test, 65 million cubic feet (1.95 million cubic meters) of vadose zone vapors were removed. The combined test periods resulted in the removal of 1,116 pounds (505 kilograms) of carbon tetrachloride and 427 pounds (193 kilograms) of trichloroethylene from the vadose zone.

## Summary of Site Risks

A Baseline Risk Assessment was conducted to evaluate current and future potential risks to human health associated with the organic contaminants found in the vadose zone beneath the RWMC. Organic contaminants that were identified as **contaminants of concern** associated with the Organic Contamination in the Vadose Zone operable unit are:

- Carbon tetrachloride
- Tetrachloroethylene
- Trichloroethylene
- 1,1,1-trichloroethane.

In addition to these organic contaminants, chloroform was also detected in the vadose zone. Chloroform was not included in the baseline risk assessment because it is not known how much, if any, chloroform was contained in the organic wastes disposed of in the Subsurface Disposal Area. Even if chloroform was not contained in the organic wastes, it can still be present as a contaminant in the vadose zone due to the natural degradation of carbon tetrachloride that was disposed. In comparison to carbon tetrachloride, chloroform is much less toxic by the route of ingestion, as evidenced by the higher groundwater **maximum contaminant level** for chloroform. However, chloroform is slightly more toxic than carbon tetrachloride by the inhalation route. If chloroform is being produced by the degradation of carbon tetrachloride, the total risk will be less than estimated because, when all exposure routes are considered, chloroform is considerably less toxic than carbon tetrachloride.

### Human Health Evaluation

As part of the human health evaluation for the Organic Contamination in the Vadose Zone, it was assumed that DOE would continue to operate and maintain the RWMC and prevent unrestricted public access to the RWMC until the year 2092. DOE Order 820.2A specifically requires active institutional control of low-level radioactive waste disposal sites for 100 years following closure. Institutional controls at the RWMC facility may include restricting land use, controlling public access, posting signs, constructing fences or other barriers, and monitoring the environment.

### Exposure Scenarios

The assessment of present and potential future exposures was based on varying locations and timeframes. Three timeframes were evaluated:

- 1) The current industrial period is expected to continue until the year 2021. During this period, potential exposure to workers at the WAG-7 boundary (200 meters) and the operable unit boundary (500 meters), and residential receptors at the INEL boundary (5,200 meters) was evaluated.
- 2) The institutional control period includes the current industrial period and extends through the year 2091. Institutional controls would be implemented to control the facility and may include, but are not limited to, restricting land use, controlling public access, posting of signs, fencing or other barriers, etc. During this period, exposure to workers and potential residents was evaluated in the same manner as for the current industrial period.,
- 3) The post-institutional period extends from 2092 to 2121 and assumes residential receptors will live at the site and will drink water from hypothetical wells located at 200, 500, and 5,200 meters from the center of the SDA. Hypothetical future receptors are located in the direction of greatest groundwater contamination, based on modeling results.

The following types of human exposure were evaluated in the baseline risk assessment:

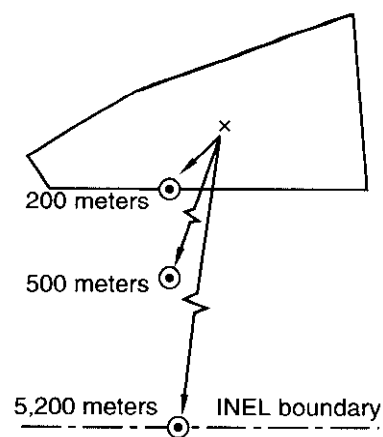
#### contaminants of concern -

contaminants which have been identified as potentially being able to cause adverse effects to human health or the environment. (see Volume 6 of the Remedial Investigation/ Feasibility Study Report, Pages 6.2 to 6.5.)

#### maximum contaminant level - (MCL)

the maximum concentration of a contaminant allowed in a public drinking water system under the Safe Drinking Water Act. For example, the MCL for carbon tetrachloride is 5 ppb, while chloroform is 100 ppb.

Three exposure locations representing a range of distances from the middle of the Subsurface Disposal Area were evaluated.



Risks were evaluated for three time periods at each location:

1992 to 2021 - Current period

1992 to 2091 - Institutional control period

2092 to 2121 - Post-institutional control period

**hazard index** - when the hazard index exceeds 1, there may be concern for potential non-carcinogenic effects.

**conservative** - overly cautious, careful, assumes overly protective conditions.

**slope factor** - a conservatively estimated value of an individual's probability of developing cancer as a result of a lifetime exposure to a particular level of a potential carcinogen. EPA sources use standardized slope factors for various chemicals.

**National Contingency Plan** - (implemented by 40 CFR 300 et seq.) - regulations implementing response actions under CERCLA, including the procedures for emergency response to release of hazardous substances.

- Outdoor inhalation of organic vapors
- Inhalation of organic vapors released from indoor use of groundwater
- Inhalation of organic vapors that have migrated through the soil into structures
- Ingestion of groundwater contaminated with organics
- Dermal absorption of organics through external uses of groundwater.

### Noncarcinogenic Health Effects

A human health evaluation results in quantifying both noncarcinogenic health effects and carcinogenic risks. Noncarcinogenic effects are expressed in terms of a **hazard index** for each contaminant assessed. The calculated hazard index indicates the potential for the most sensitive individuals, such as children, to be adversely affected. Hazard indices are compared to a threshold value of one, established by the EPA as the level above which there is the potential of noncarcinogenic effects on exposed individuals. Noncarcinogenic estimates for the three time periods evaluated in the baseline risk assessment are listed in Table 1. The hazard indices estimated for the current period are less than 1 except for the worker at the Subsurface Disposal Area boundary. The estimated hazard index of 2 for the current worker is related to outdoor inhalation of organic contaminants. This estimate is based on **conservative** assumptions associated with exposure duration and the air model used to predict outdoor concentrations of organics contaminants. Due to the conservative nature of these assumptions, the actual hazard index for this receptor is expected to be less than 1. For the institutional and post-institutional control scenarios, hazard indices greater than 1 were calculated for each of the residential receptors. The primary exposure routes for these hazard indices are ingestion of groundwater and inhalation of organic vapors released from indoor use of groundwater.

### Carcinogenic Risk

Carcinogenic risk is expressed as a product of a receptor's total expected lifetime exposure to a particular contaminant and a **slope factor** for the contaminant. The calculated product, referred to as an excess lifetime cancer risk, indicates the potential increase in cancer occurrences as a result of human exposure to the carcinogenic contaminant. As described in the **National Contingency Plan**, contaminants present in sufficient concentrations to create an excess lifetime cancer risk within or less than the range of 1 chance in 10,000 to 1 chance in 1,000,000 is considered acceptable by the EPA.

As outlined in Table 1, carcinogenic risks are estimated to be below or within the acceptable risk range for all receptors under the current scenario and for the worker receptors under the institutional control scenario. An estimated two additional residential receptors out of 10,000 are at risk of developing cancer for the institutional and post-institutional scenarios (refer to Table 1). This excess cancer risk is primarily related to ingestion of groundwater contaminated with organic compounds. The risk increases with increasing concentrations of organic compounds in groundwater. Therefore, organic contamination present in the vadose zone, if not addressed by the preferred alternative or one of the other alternatives, could migrate to the Snake River Plain Aquifer and contaminate the groundwater to a degree that results in risks to human health that are slightly above the acceptable risk range.

### Limitations of Assumptions

The estimates of carcinogenic and noncarcinogenic risks are based on conservative assumptions associated with both the fate and transport modeling and the risk assessment. While potential health problems have formed the basis for the agencies' recommendation for action, it must be noted that there is considerable uncertainty in the results of the modeling and risk assessment. Given the conservative nature of assumptions used, it is likely that the potential for actual health problems have been overestimated. The uncertainty associated with the risk assessment is discussed in Section 6.1.5 of the RI report (page 6-60).

**Table 1. Summary of Baseline Risk Assessment Results.**

Receptor <sup>a</sup>	Exposure Timeframe	Carcinogenic Risk <sup>b</sup>	Noncarcinogenic Risk (Hazard Index) <sup>c</sup>	Primary Contributing Exposure Route
<b>Current Scenario (1992 to 2021)</b>				
Worker - 200 meters (SDA Boundary)	1992 - 2016	6 in 100,000 ( $6 \times 10^{-5}$ )	2	Air
Worker - 500 meters	"	4 in 1,000,000 ( $4 \times 10^{-6}$ )	0.1	"
Resident adult - 5,200 meters (southern INEL Boundary)	1992 - 2021	1 in 100,000 ( $1 \times 10^{-5}$ )	0.3	Groundwater
Resident child - 5,200 meters	"	— d	0.3	"
<b>Institutional Control Scenario (1992 to 2091)</b>				
Worker - 200 meters <sup>e</sup>	2062 - 2086	9 in 10,000,000 ( $9 \times 10^{-7}$ )	0.03	Air
Worker - 500 meters <sup>e</sup>	"	2 in 1,000,000 ( $2 \times 10^{-6}$ )	0.07	"
Resident adult - 5,200 meters	2062 - 2091	2 in 10,000 ( $2 \times 10^{-4}$ )	5	Groundwater
Resident child - 5,200 meters	"	— d	6	"
<b>Post-Institutional Control Scenario (2092 to 2121)</b>				
Resident adult - 200 meters	2092 - 2121	2 in 10,000 ( $2 \times 10^{-4}$ )	6	Groundwater
" " - 500 meters	"	"	3	"
" " - 5,200 meters	"	"	5	"
Resident child - 200 meters	"	— d	5	"
" " - 500 meters	"	— d	7	"
" " - 5,200 meters	"	— d	5	"

a. Risks are calculated for three different distances from receptor to center of Subsurface Disposal Area. 200 meters = 656 feet, 500 meters = 1,640 feet, 5,200 meters = 17,060 feet.

b. The NCP defines an acceptable level of carcinogenic risk as less than 1 additional incidence of cancer in 10,000 to 1,000,000 individuals ( $10^{-4}$  to  $10^{-6}$ ).

c. A hazard index (the ratio of the level of exposure to an acceptable level) greater than 1 indicates that there may be concern for noncarcinogenic effects. Hazard indices listed are cumulative across all exposure pathways.

d. Carcinogenic risks are calculated for the population exposed over a period of time to contaminant concentrations for which cancer is typically observed.

e. Concentration of carbon tetrachloride in the Snake River Plain Aquifer beneath the Subsurface Disposal Area is predicted by the model to peak in the year 2071 at a concentration of about 125 mg/m<sup>3</sup> (ppb). However, ingestion of groundwater by workers during the institutional control scenario was not considered in the risk assessment due to institutional controls preventing the use of Snake River Plain Aquifer water above MCLs by workers.

## Fate and Transport Modeling

To aid in evaluating potential risks, *fate and transport modeling* was used to predict the migration of organic contaminants through the vadose zone assuming that no action is taken. The model used data obtained during the remedial investigation on the contaminants and on the physical characteristics of the vadose zone to predict the movement of the contaminants through the vadose zone over a period of time extending 200 years into the future. The vadose zone model predicts the amount of organic contaminants released to the atmosphere and reaching the Snake River Plain Aquifer. Based on the modeling results, the concentrations of contaminants being released to the atmosphere have peaked and will decrease with time. The contaminant concentrations in groundwater beneath the RWMC are predicted to peak about 77 years from now, which, due to institutional controls, is before the public could access the underlying groundwater. The model predicts that carbon tetrachloride concentrations in the Snake River Plain Aquifer beneath the Subsurface Disposal Area will peak at about 125 parts per billion in the year 2071 due to the continued downward movement of the most concentrated portion of the organic vapor plume. This concentration is above the maximum contaminant level of five parts per billion for carbon tetrachloride.

**fate and transport modeling** - computer simulations of the natural environment, performed to estimate the transport of a contaminant through environmental media in order to provide input to the baseline risk assessment to estimate current and future risk.

**remedial action objectives** - goals set in accordance with EPA guidance for protection of human health and environmental receptors from potential adverse effects of contaminants in any media. Usually include targeted cleanup goals.

## Remedial Action Objectives

As part of the remedial investigation/feasibility study process, **remedial action objectives** were developed in accordance with the National Contingency Plan and EPA guidance. The intent of the remedial action objectives is to set goals for protection of human health and the environment. The goals are designed specifically to mitigate the potential adverse effects of vadose zone contaminants that could enter the air or groundwater.

The results of the remedial investigation and baseline risk assessment indicated that the contamination of groundwater due to the migration of the vadose zone organic contaminants to the Snake River Plain Aquifer will present the most significant future risk to human health if no action is taken. The primary remedial action objective, and the focus of remedial action alternative development, is preventing organic contaminant migration to the groundwater that would result in groundwater contaminant concentrations exceeding acceptable risk levels and/or federal and state maximum contaminant levels. To ensure that this remedial action objective is met, a long-term groundwater and soil vapor monitoring program would be conducted. The monitoring program would be designed to provide an early indication of the possibility of future groundwater contamination.

## Summary of Alternatives

The feasibility study conducted for this operable unit provided a detailed analysis of those alternatives that meet the screening criteria. The screening process focused on evaluating an alternative's effectiveness at achieving the stated remedial action objectives and its ability to be implemented at the site. Of the alternatives that were developed as part of the feasibility study, the screening process resulted in the selection of three remedial action alternatives, which were sufficiently distinct, yet implementable and effective. These alternatives include:

**Alternative 1:** Containment of Vadose Zone Contaminants by Capping

**Alternative 2:** Extraction/Treatment by VVE

**Alternative 3:** Extraction/Treatment by VVE with Vaporization Enhancement

Although Alternative 4: In Situ Bioremediation was also developed, it was screened from consideration early in the feasibility study process due to site characteristics, such as the fractured nature of the basalt and the extensive size of the contaminant plume, which severely limit the ability to implement an in situ application of bioremediation at the Subsurface Disposal Area. The alternatives that passed the screening criteria, along with the No Action alternative, which was included as a baseline against which all other alternatives were compared, are described below.

Alternatives 1, 2, and 3 involve remedial actions, and must meet all **Applicable or Relevant and Appropriate Requirements** (ARARs). The primary ARARs for these alternatives include:

- Idaho Rules, Regulations and Standards for Hazardous Waste (IDAPA § 16.01.05)
- Miscellaneous Units (40 CFR 264.600 et seq)
- Clean Air Act (40 CFR 61.92 and 40 CFR 61.240)
- Idaho Ambient Air Quality Standards (IDAPA § 16.01.1101.01)
- Idaho Rules for Control of Fugitive Dust (IDAPA § 16.01.1251-1253)
- Idaho Standards of Performance for New Stationary Sources (IDAPA § 16.01.1952).

**Applicable or Relevant and Appropriate Requirements** (ARARs) - "Applicable" requirements mean those standards, criteria, or limitations promulgated under federal or state law that are required specific to a substance, pollutant, contaminant, action, location, or other circumstance at a CERCLA site. "Relevant and Appropriate" requirements mean those standards, requirements, or limitations that address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to that particular site.

These regulations focus on the control of hazardous waste and the regulation of air emissions that may result from any remediation activities at the Organic Contamination in the Vadose Zone operable unit. Therefore, these ARARs are requirements that govern the handling of residual hazardous wastes that may be generated from remediation activities and emissions from vapor treatment systems as well as potential dust-generating activities (e.g., well drilling, earth moving, etc.). There are currently no regulations established that govern the cleanup levels for vapor-phase contaminants in soil.

**Alternative 0: No Action**

Under this alternative, no attempt would be made to contain, treat in place, or extract and treat the organic contaminants present within the vadose zone. Instead, only long-term groundwater and soil vapor monitoring would be implemented. Groundwater monitoring is necessary to detect contaminant concentrations in the Snake River Plain Aquifer. Soil vapor monitoring is necessary to track the migration of contaminant vapors in the vadose zone. Changes in contaminant concentrations in groundwater and soil vapor would be evaluated to determine whether measures must be taken to minimize potential risks to public health and the environment. There were no ARARs identified for the No Action alternative. Costs for implementing groundwater and soil vapor monitoring under this alternative for the next 30 years are estimated to be \$4.1 million.

**Alternative 1: Containment of Vadose Zone Vapors by Capping**

Alternative 1 consists of the installation of a cap over the Subsurface Disposal Area to minimize infiltration of rainwater, surface water, and snowmelt into the subsurface. Capping would reduce the amount of infiltrating moisture that reaches the waste buried in the Subsurface Disposal Area and contributes to downward migration of organic contaminants in the vadose zone. Capping is the systematic covering of an area with layers of soil, clay, and/or synthetic material that would be used, in this case, to provide a relatively impermeable barrier to surface water. Typical applications of capping are municipal landfills where contaminated water (i.e., leachate) is formed via infiltrating surface water.

A cap of the Subsurface Disposal Area would consist of three layers of earthen fill over the entire 88-acre surface of the Subsurface Disposal Area. A layer of compacted fill would first be applied at the Subsurface Disposal Area to provide a uniformly graded surface that is contoured to allow quick surface water runoff from the center of the cap outward. The fill layer would subsequently be covered with a low permeability clay material, followed by a vegetated surface soil layer.

Under Alternative 1, no removal and treatment of organic contaminants would occur. Even with a cap in place, organic contaminants would continue to migrate laterally and vertically in the vadose zone, primarily in the vapor phase. By minimizing the infiltration of water, capping would limit the contact of water with organic contaminants at shallow depths; thus, migration of organic contaminants dissolved in infiltrating moisture would decrease.

The only ARAR identified for this alternative was Idaho Rules for Control of Fugitive Dust (IDAPA § 16.01.1251-1253). This ARAR would be met during the construction of a cap through appropriate engineering controls to minimize dust generation.

The cost of Alternative 1 is estimated to be \$43.3 million, including a nine million dollar contingency to cover unanticipated costs, associated with capping materials acquisition. It is expected that it would take no more than 20 workers five years to construct the cap. As such, there are no significant socio-economic impacts associated with this alternative. Periodic maintenance of the cap would be needed to maintain its integrity. In addition, soil vapor and groundwater monitoring would be conducted to monitor the migration of organic contaminants in the vadose zone and Snake River Plain Aquifer.

**Alternative 0**

**No Action:**

- Contaminants would remain in place
- Groundwater monitoring would be required for 30 years
- Cost - \$4.1 million

**Alternative 1**

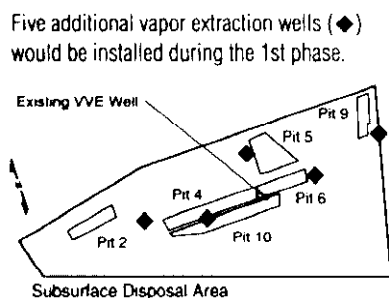
**Containment of Vadose Zone Vapors by Capping:**

- Contaminants would remain in place
- Entire 88-acre Subsurface Disposal Area would be capped
- Capping would reduce infiltrating moisture reaching waste
- Cost - \$43.3 million

### Alternative 2

#### Extraction/Treatment by VVE:

- Organic vapors would be removed and treated
- Phased approach would allow additional extraction and monitoring wells, and vapor equipment treatment
- Cost - \$12.9 to 32.4 million depending on phases needed



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### Alternative 2: Extraction/Treatment by VVE

Alternative 2 uses VVE to remove organic vapors from the vadose zone. Extracted vapors are subsequently treated at the surface. This alternative utilizes the existing VVE extraction well and several additional extraction wells that would be located in areas of the Subsurface Disposal Area known to have significant levels of organic vapors in the vadose zone. The existing VVE system was installed to determine the viability of VVE as a technology for the recovery and treatment of the vadose zone contaminants. The system consists of one vapor extraction well, a blower, and a carbon adsorption vapor treatment system. The extraction well is configured to recover vapor organic contaminants from above and below the 110-foot interbed.

Figure 3 shows a conceptual cross-sectional view of the VVE system with geological features of the vadose zone and a conceptual representation of the vapor contaminant plume. Under a phased approach to Alternative 2, the existing VVE system would be augmented with additional extraction wells, monitoring wells, and vapor treatment equipment. The first phase would include the installation of five additional extraction wells (see figure in the sidebar - note that locations are approximate) to augment the contaminant recovery capability of the existing vapor extraction well. Additional vapor treatment units and vapor monitoring wells would support these five wells. Subsequent phases may also include more vapor extraction wells, monitoring wells, and vapor treatment units. The maximum number of vapor extraction wells and accompanying vapor treatment units expected under a third phase of Alternative 2 operation would be 14. The phased approach is discussed in greater detail under Summary of Preferred Alternative on page 17. In addition to contaminant recovery and treatment, Alternative 2 would include long-term soil vapor and groundwater monitoring.

Each vapor extraction well would be linked to a catalytic oxidation unit, or equivalent vapor treatment system with a treatment efficiency approaching 99 percent, capable of maintaining an airflow that would range between 125 and 150 cubic feet per minute. Catalytic oxidation was included as the representative process option for vapor treatment because of its ability to destroy the contaminants, its availability in modular compact units that could be placed adjacent to each vapor extraction well, and its relatively low operation and maintenance costs. Potentially, one catalytic oxidation unit would be dedicated to each extraction well due to the large distances between wells.

The feasibility study considered other vapor treatment technologies such as biological treatment, ultraviolet treatment, and carbon adsorption. Based on available performance data, biological and ultraviolet treatment would require further development in order to be a viable vapor treatment option for the large-scale application that would be required under Alternative 2. Carbon adsorption has already been demonstrated as a viable vapor treatment option; however, difficulties associated with the handling and regeneration of contaminant-saturated carbon must be resolved in order to utilize this technology for large-scale vapor treatment at the RWMC. Further investigation of available vapor treatment technologies that would be most appropriate to support VVE at Operable Unit 7-08 would continue through the design of Alternative 2.

Each of the ARARs identified for this alternative would be met through appropriate engineering controls such as vapor treatment. It is expected that no residual treatment wastes would be generated under Alternative 2. Costs for implementing this alternative range from \$12.9 to \$32.4 million. The cost range corresponds to first phase operations through third phase operations for a period of two years to six years, respectively. The costs include an assumption for soil vapor and groundwater monitoring for a minimum of 30 years. It is estimated that a maximum of 10 workers would be required to complete this alternative. As such, there would be no significant socio-economic impacts associated with this alternative.

### Alternative 3

#### Extraction/Treatment by VVE with Vaporization Enhancement:

- Same VVE recovery method as in Alternative 2, but with radio frequency heating to enhance vaporization of organics
- 14 extraction wells and 14 boreholes to accommodate radio frequency heating antennae would be installed
- Cost - \$59.9 million

### Alternative 3: Extraction/Treatment by VVE with Vaporization Enhancement

Alternative 3 includes VVE (as described for Alternative 2) as the primary contaminant recovery method with radio frequency heating to enhance the vaporization of organic contamination in the vadose zone. Radio frequency heating would target contaminants that have dissolved in soil moisture or perched water, or have adsorbed onto material in the sedimentary interbeds. Radio frequency heating uses strategically placed antennae in boreholes to raise the temperature in discrete areas of the subsurface. The increased temperature induces vaporization of the organic contaminants. These vaporized contaminants can then be recovered by the VVE system. The VVE system under Alternative 3 includes 14 vapor extraction wells (equivalent to the third-phase operation that would be implemented as part of Alternative 2) and 14 boreholes installed to the 110-foot interbed to accommodate the insertion of the radio frequency heating antennae.

Each of the ARARs identified for this alternative would be met as discussed for Alternative 2. Costs for implementing Alternative 3 are estimated to be \$59.9 million. This cost is based on operation of a full network of VVE wells (as described for the potential third phase of operation under Alternative 2) and no more than two radio frequency heating antennae operating at any given time over a period of six years. The costs include an assumption for soil vapor and groundwater monitoring for a minimum of 30 years. It is estimated that no more than 10 workers would be required to complete this alternative. As such, there are no significant socio-economic impacts associated with Alternative 3.

## Evaluation of Alternatives

Each of the alternatives subjected to detailed analysis were evaluated against eight of the nine *evaluation criteria* identified under CERCLA. Brief definitions and the categorization of all nine criteria are provided in the sidebar. The ninth criterion, community acceptance, will be evaluated when public response to the proposed remedial action for the Organic Contamination in the Vadose Zone is received. Evaluations against the first eight evaluation criteria are summarized in the following sections. Each alternative must meet the threshold criteria to be considered for selection as the preferred remedial action alternative.

### Overall Protection of Human Health and the Environment

Alternatives 2 and 3, Extraction/Treatment by VVE and Extraction/Treatment by VVE with Vaporization Enhancement, respectively, meet the criterion of overall protection of human health and the environment. The alternatives accomplish this by recovering and treating organic vadose zone contaminants, thus, preventing unacceptable levels of contaminant migration to the Snake River Plain Aquifer and also potentially reducing the mass flow of the contaminants to the surface soils and atmosphere above the RWMC. Alternatives 2 and 3 provide protection of groundwater by preventing maximum contaminant levels for the contaminants associated with the Organic Contamination in the Vadose Zone from being exceeded. There are no significant differences in the level of protection of human health and the environment provided by Alternatives 2 and 3.

Alternative 1, Containment of Vadose Zone Contaminants by Capping, also satisfies this criterion to the degree that it protects human health by reducing the level of contaminant migration to the Snake River Plain Aquifer and by reducing the mass flow of contaminants to the environment at the surface of the RWMC. It is not clear, however, how much of a reduction in the amount of organic contaminants reaching the Snake River Plain Aquifer would occur under this alternative, and whether contaminant concentrations would exceed maximum contaminant levels in the future. This uncertainty stems in part from the potential migration of contaminants at greater

### Evaluation Criteria

#### Threshold Criteria:

1. **Overall Protection of Human Health and the Environment** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** addresses whether a remedy will meet all of the ARARs under federal and state environmental laws and/or justifies a waiver.

#### Balancing Criteria:

3. **Long-term Effectiveness and Permanence** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.
4. **Reduction of Toxicity, Mobility, or Volume through Treatment** addresses the degree to which a remedy employs recycling or treatment that reduces the toxicity, mobility, or volume of the contaminants of concern, including how treatment is used to address the principal threats posed by the site.
5. **Short-term Effectiveness** addresses any adverse impacts on human health and the environment that may be posed during the construction and implementation period and the period of time needed to achieve cleanup goals.
6. **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.
7. **Cost** includes estimated capital and operation and maintenance costs, expressed as net present-worth costs.

#### Modifying Criteria:

8. **State Acceptance** reflects aspects of the preferred alternative and other alternatives that the state favors or objects to, and any specific comments regarding state ARARs or the proposed use of waivers.
9. **Community Acceptance** summarizes the public's general response to the alternatives described in the Proposed Plan and in the remedial investigation/feasibility study, based on public comments received.

## **INEL Information Repositories**

### **INEL Technical Library**

DOE-ID Public Reading Room  
1776 Science Center Drive  
Idaho Falls, ID 83415  
(208) 526-1185

### **INEL Pocatello Office**

1651 Al Ricken Dr.  
Pocatello, ID 83201  
(208) 233-4731

### **INEL Twin Falls Office**

233 2nd Street North, Suite B  
Twin Falls, ID 83301  
(208) 734-0463

### **INEL Boise Office**

816 West Bannock, Suite 306  
Boise, ID 83702  
(208) 334-9572

### **University of Idaho Library**

University of Idaho Campus  
Moscow, ID 83843  
(208) 885-6344

### **Shoshone Bannock Library**

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Bannock and Pima Streets  
Fort Hall, ID 83203  
(208) 238-3882

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(208) 334-9572

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530 S. Ashbury  
Moscow, ID  
(208) 882-6668

depths that may still be affected by water infiltrating from areas outside of the Subsurface Disposal Area. Capping would not affect organic contaminants in the vadose zone that have migrated laterally beyond the boundary of the Subsurface Disposal Area. Although not considered an ARAR for this operable unit, it is likely that contaminant concentrations in the aquifer would exceed maximum contaminant levels in the future under this alternative.

Overall, each of the alternatives, with the exception of Alternative 0, No Action, would result in a lifetime excess cancer risk within the acceptable range of 1 in 10,000 to 1 in 1,000,000. Alternative 1 would accomplish this by reducing the migration of contaminants to the Snake River Plain Aquifer through a reduction in moisture infiltration at the surface of the Subsurface Disposal Area. Alternatives 2 and 3 would accomplish this by recovering and treating the most significant levels of vadose zone contaminants present. Although there is some uncertainty in the modeling results, it is believed that the No Action alternative would not satisfy the criterion of Overall Protection of Health and the Environment.

### **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)**

Each of the alternatives meets the identified ARARs through engineering controls and operating procedures. There are no ARARs identified for the No Action alternative. The primary ARARs considered when evaluating the remedial alternatives for the Organic Contamination in the Vadose Zone are discussed in the Summary of Alternatives section. These are action-specific ARARs that focus on the control of hazardous waste and the regulation of air emissions that may result from any remediation activities at the Organic Contamination in the Vadose Zone operable unit. Therefore, these ARARs are requirements that govern the handling of residual hazardous wastes that may be generated from remediation activities and emissions from vapor treatment systems as well as potential dust generating activities (e.g., well drilling) associated with Alternatives 1, 2, and 3.

### **Long-Term Effectiveness and Permanence**

Alternatives 2 and 3 provide the greatest level of long-term effectiveness and permanence by targeting for recovery and treatment vapor contaminants present throughout the upper portion of the vadose zone at the RWMC. Alternative 2 provides a slightly lower level of long-term effectiveness than Alternative 3 because it does not incorporate an option to enhance contaminant recovery/degradation. In other words, Alternative 2 has a slightly greater potential to leave untreated contaminants in the vadose zone than Alternative 3, although this potential is considered to be fairly insignificant. A degree of risk would remain with Alternatives 2 and 3 because it is not possible to remove and treat all of the vadose zone organic contaminants. Alternative 1 also provides long-term effectiveness and permanence, but to a lesser degree than Alternatives 2 and 3 due to uncertainties associated with its performance and due to its lack of contaminant removal and treatment. That is, Alternative 1 is a less reliable remedy, and the degree of risk remaining after it is implemented would be greater than the risk remaining under Alternatives 2 or 3.

The No Action alternative provides the lowest level of long-term effectiveness and permanence as it provides no recovery or measures to reduce the migration of the contaminants currently migrating through the vadose zone toward the Snake River Plain Aquifer.

### **Reduction of Toxicity, Mobility, or Volume through Treatment**

Alternatives 2 and 3 each provide a reduction in the volume of organic contaminants present in the vadose zone beneath and within the immediate vicinity of the RWMC. The reduction in volume is accomplished by removing vapors with a VVE system and treating the removed organic contaminants. Alternative 3 offers an advantage over Alternative 2 because it has a greater potential to achieve the necessary organic con-

taminant removal more effectively by enhancing the recovery of the VVE system through heating of areas of the vadose zone. The overall improvement in contaminant recovery afforded by Alternative 3 over Alternative 2 cannot be fully evaluated at this time. Based on the limited data, an assumption can be made, however, that some benefit to contaminant recovery would be realized.

Alternative 1 does not provide any treatment of the contaminants present; however, it does limit the mobility of contaminants present in the vadose zone by minimizing the infiltration rate directly below the Subsurface Disposal Area.

The No Action alternative provides no reduction in toxicity, mobility, or volume of the contaminants present in the vadose zone at the RWMC.

### Short-term Effectiveness

In general, alternatives requiring the least amount of construction and/or operation and handling of equipment, residual wastes, etc., rank the highest in terms of short-term effectiveness. As such, the No Action alternative ranks high under this criterion because it requires no additional on-site activities and does not result in additional acute hazards to the public or the environment.

Alternative 2 ranks slightly higher than Alternative 3 because it is simpler in terms of the amount of equipment and operations personnel involved. Each of these alternatives has a slight potential for worker risks through physical hazards associated with borehole installation and operation/maintenance of the contaminant treatment system. Alternative 3 has additional worker risk associated with the operation of the radio frequency heating system (e.g., electrical and heating hazards). There would be no significant increase in potential risks to the public under any of these treatment alternatives. This is mainly due to the fact that the bulk of the contaminants would remain isolated from the surface environment in their present form within the vadose zone beneath the RWMC. Those contaminants brought to the surface would be controlled by a surface-based vapor treatment system designed to destroy contaminants on site. The operation of this treatment system would be monitored to ensure releases of contaminants to the environment do not exceed acceptable air emission levels.

Alternative 1 ranks the lowest of the considered alternatives under this criterion. This alternative would require a significant level of construction activities associated with the installation of a cap over the Subsurface Disposal Area. Potential risks to workers, including risks associated with the transportation of needed construction materials to the RWMC, outweigh all other elements under short-term effectiveness.

### Implementability

Each of the alternatives retained for detailed evaluation is implementable. Alternative 3 ranks lower than Alternatives 2 or 0 for implementability because of its slightly greater complexity in equipment procurement, installation, and operation. Alternative 1 ranks lower than all of the alternatives because of potential difficulties associated with construction of the cap, including coordination with potential cleanup actions for other operable units at the RWMC and procurement of extensive amounts of materials.

Long-term monitoring under these alternatives would detect any serious failure in recovering or containing vadose zone contaminants, allowing appropriate steps to be taken to preclude significant exposures to contaminated groundwater from the Snake River Plain Aquifer. Each of the alternatives ranks equally with regard to the implementability of a long-term monitoring program.

### Cost

Table 2 summarizes the cost estimates for each alternative. These cost estimates, in present dollar value, include **direct costs** and **indirect costs** associated with construc-



#### The U.S. Environmental Protection

**Agency** is one of the three agencies identified in the Federal Facility Agreement which establishes the scope and schedule of remedial investigations at the INEL. Correspondence by the Region 10 staff concerning this project can be found in the Administrative Record under Operable Unit 7-08.

For additional information concerning the EPA's role in preparing this proposed plan contact:

Wayne Pierre  
Environmental Protection Agency  
Region 10  
1200 Sixth Avenue, Seattle, WA 98101  
(206) 553-7261

**direct costs** - the estimated dollars for equipment, construction and operation required activities to conduct a remedial action.

**indirect costs** - the estimated dollars for activities that support the remedial action (e.g., construction management, project management, management reserve, etc.)

**Table 2. Organic Contamination in the Vadose Zone Alternative Cost Summary <sup>a</sup>**

Cost Elements	Alternative 0	Alternative 1	Alternative 2			Alternative 3
	No Action	Capping (3% Grade)	VVE Phase I	VVE with Phase 2	VVE with Phase 3	VVE with RF Heating
<b>Construction</b>						
RF Boreholes/Heating Equipment	\$0	\$0	\$0	\$0	\$0	\$348,160
Construction of Cap	\$0	\$16,296,289	\$0	\$0	\$0	\$0
VVE Monitoring Wells	\$0	\$0	\$558,800	\$967,371	\$1,337,117	\$1,419,920
Field Personnel	\$0	\$0	\$76,200	\$131,337	\$181,235	\$225,450
Site Improvements	\$0	\$92,510	\$11,025	\$21,003	\$40,291	\$47,101
Treatment System/Discharge Monitor	\$0	\$340,725	\$583,473	\$937,257	\$1,257,423	\$1,363,320
Additional Direct Costs	\$0	\$970,811	\$132,691	\$219,740	\$299,603	\$348,981
Project Supervision and Engineering	\$0	\$12,390,235	\$955,532	\$1,597,506	\$2,186,414	\$2,629,052
Contingency	\$0	\$9,027,171	\$695,316	\$1,162,264	\$1,590,624	\$1,914,595
<b>Construction Subtotal</b>	<b>\$0</b>	<b>\$39,117,741</b>	<b>\$3,013,037</b>	<b>\$5,036,479</b>	<b>\$6,892,706</b>	<b>\$8,296,579</b>
<b>Operations and Maintenance</b>						
Technical Support	\$0	\$0	\$75,253	\$211,765	\$373,403	\$687,822
Operating/Maintenance Labor	\$0	\$9,148	\$144,320	\$295,623	\$451,363	\$547,444
Materials & Equipment	\$0	\$41,161	\$132,735	\$340,475	\$608,127	\$6,366,774
Vapor Sampling	\$0	\$0	\$1,805,660	\$4,126,717	\$6,851,732	\$9,052,916
Additional Direct Costs	\$0	\$13,031	\$83,919	\$203,022	\$344,740	\$3,802,779
Project Supervision & Engineering	\$0	\$44,340	\$1,569,320	\$3,624,321	\$6,040,555	\$14,320,416
Contingency	\$0	\$32,30	\$1,143,363	\$2,640,578	\$4,400,977	\$10,433,447
<b>Operation and Maintenance Subtotal</b>	<b>\$0</b>	<b>\$139,983</b>	<b>\$4,954,569</b>	<b>\$11,442,502</b>	<b>\$19,070,897</b>	<b>\$45,211,597</b>
<b>Post Closure Monitoring</b>						
Well Closure/Demolition	\$0	\$0	\$7,673	\$11,227	\$14,241	\$24,196
Vapor & Groundwater Monitoring	\$2,608,268	\$2,068,268	\$3,128,250	\$3,390,684	\$3,943,952	\$3,943,952
Project Management	\$521,647	\$521,647	\$625,644	\$747,643	\$869,642	\$869,642
Contingency	\$938,975	\$938,975	\$1,126,171	\$1,345,763	\$1,565,355	\$1,565,355
<b>Post Closure Monitoring Subtotal</b>	<b>\$4,068,890</b>	<b>\$4,068,890</b>	<b>\$4,877,738</b>	<b>\$5,495,316</b>	<b>\$6,393,189</b>	<b>\$6,403,144</b>
<b>Total <sup>b</sup></b>	<b>\$4,070,000</b>	<b>\$43,330,000</b>	<b>\$12,860,000 <sup>c</sup></b>	<b>\$21,970,000 <sup>c</sup></b>	<b>\$32,360,000 <sup>c</sup></b>	<b>\$59,910,000</b>

<sup>a</sup> All costs represent 1994 dollars with a 5% annual inflation rate.<sup>b</sup> The total costs have been rounded to the nearest \$10,000.<sup>c</sup> Total costs shown for phases of Alternative 2 are cumulative.

tion and operations and maintenance, as well as post-closure costs for long-term monitoring. Costs for Alternative 2 are provided for each of the three phases of VVE system operation that may be implemented. The total cost of each phase is cumulative in that it includes costs from each prior phase. Contingency costs have been included for each of the three primary cost elements (i.e., construction, operations and maintenance, and annual post closure monitoring). These costs represent an estimate of unforeseen but necessary costs. Generally, contingency is reduced as details of the design for a particular remedial action alternative are refined.

#### State Acceptance

IDHW has been involved in preparing this Proposed Plan. The Proposed Plan is issued with the concurrence of the IDHW.

## Summary of Preferred Alternative

The preferred remedial action for the Organic Contamination in the Vadose Zone is the first phase of Alternative 2: Extraction/Treatment by VVE. The agencies believe that this alternative satisfies the statutory requirements of CERCLA section 121(b). This alternative provides overall protection of human health and the environment, complies with ARARs, provides long- and short-term effectiveness, is readily implementable, and is cost effective. Alternative 2 focuses on the recovery of vapor-phase contaminants from the vadose zone beneath the RWMC through the use of VVE. By implementing the first phase of Alternative 2, the agencies believe that the most significant concentrations of organic contaminants in the vadose zone would be removed and destroyed. Reducing the concentration of organic contaminants in the vadose zone now will reduce the amount of contaminants migrating to the Snake River Plain Aquifer in the future. This reduction in contaminant migration will ensure that risks to future groundwater users are within acceptable guidelines and that contaminant concentrations in the aquifer remain below state maximum contaminant levels.

Tests conducted in 1989 and 1993 with the existing VVE system demonstrated that VVE can reduce vadose zone organic contaminant concentrations. In fact, the existing VVE system was able to influence organic contaminant concentrations in subsurface locations as far away as 450 feet from the vapor extraction well. Based on these results, it is believed that an array of vapor extraction wells at selected locations of the RWMC will effectively reduce contaminant concentrations in the vadose zone to acceptable levels.

The alternative will be designed so that the remedial system meets preliminary targeted cleanup goals. These goals have been established as vadose zone vapor contaminant concentrations that will not result in groundwater contaminant concentrations exceeding state maximum contaminant levels, or resulting in unacceptable risks to future groundwater users. Establishing these cleanup goals for the vadose zone beneath the RWMC involved the use of the fate and transport model used to predict contaminant migration to the Snake River Plain Aquifer. The targeted cleanup goal for carbon tetrachloride ranges from 30 to 200 **parts per million volume** (ppmv), depending on the depth within the vadose zone. The other vadose zone contaminants have similar cleanup goals. Contaminants remaining in the vadose zone after implementation of the preferred alternative would not result in unacceptable future risks to human health and the environment.

The complexities of the subsurface environment and uncertainty associated with the modeling, make it difficult to predict how many wells will eventually be needed, how long it would take to achieve cleanup goals, and at what point the agencies could safely turn off the system. In consideration of these issues and for the purpose of estimating costs, three phases of cleanup activity over 6 years were assumed for Alternative 2. The agencies believe, however, that the preferred remedial action should be implementation of the first phase of Alternative 2.

As part of the first phase, five new vapor extraction wells would be installed to augment the existing VVE well. Additional vapor monitoring wells would be installed for each extraction well to monitor the reduction of contaminant concentrations in soil vapor resulting from VVE operations at each location. If, following an evaluation of the implemented remedy (approximately two years after implementation), the agencies conclude that the indications from modeling and monitoring show that vadose zone contamination is not being sufficiently reduced to prevent federal and state MCLs from being significantly exceeded in the aquifer, additional phases of Alternative 2 will be proposed. A second phase could consist of adding more extraction wells, deepening extraction wells, or including passive venting wells. Again, if after two



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DIVISION OF  
ENVIRONMENTAL QUALITY

The Idaho Department of Health and Welfare is one of the three agencies identified in the Federal Facility Agreement which establishes the scope and schedule of remedial investigations at the INEL. Project correspondence by the Division of Environmental Quality staff can be found in the Administrative Record for this project under Operable Unit 7-08. For additional information concerning the state's role in preparing this proposed plan contact:

Dean Nygard  
Division of Environmental Quality  
Idaho Department of Health and Welfare  
1410 N. Hilton, Boise, ID 83706  
(208) 334-5860, (800) 232-4635

### Highlights of Alternative 2

- The most significant concentrations of organic contaminants in the vadose zone would be removed and destroyed
- The existing VVE system has demonstrated its effectiveness at removing the subsurface organic contaminants during initial testing of the system
- The existing VVE system was able to reduce vadose zone organic contaminant concentrations as far away as 450 feet from the vapor extraction well
- Contaminants remaining in the vadose zone after implementation of Alternative 2 would not result in unacceptable future risks to human health and the environment
- The targeted cleanup goal for carbon tetrachloride ranges from 30 to 200 parts per million volume (ppmv)
- Alternative 2 would include long-term groundwater and soil vapor monitoring to confirm the ability of the VVE system to prevent contaminants from migrating to the Snake River Plain Aquifer

**parts per million volume (ppmv)** - a ratio of volume of contaminant to the total volume of contaminant and media (usually air). Example: 1 ppmv carbon tetrachloride can mean 1 liter of carbon tetrachloride (vapor) in 1 million liters of air.



The **Department of Energy** is one of the three agencies identified in the Federal Facility Agreement which establishes the scope and schedule of remedial investigations at the INEL. Project correspondence by the DOE staff can be found in the Administrative Record for this project under Operable Unit 7-08.

*Written comments concerning this plan can be submitted to the U.S. Department of Energy Idaho Operations Office, and addressed to:*

*Mr. Jerry Lyle  
Acting Deputy Assistant Manager  
Office of Program Execution  
DOE-Idaho  
P.O. Box 2047  
Idaho Falls, ID 83403-2047*

*For additional information regarding the environmental restoration program at the INEL, call Reuel Smith at the INEL Community Relations Plan office at 1-208-526-6864, or call 1-800-708-2680.*

more years of operation the VVE system still requires further modification, additional extraction wells could be added. For planning and costing purposes, it was assumed that four additional extraction wells would be added during each phase, bringing the total number of wells to 14 if a third phase is implemented. The actual number and location of extraction wells that could be added during the second and third phases may vary, depending on the effectiveness of the initial system in reducing contaminant concentrations.

In addition to the recovery and treatment of the vadose zone contaminants, Alternative 2 would include long-term groundwater and soil vapor monitoring to confirm the ability of the VVE system to prevent contaminants from migrating to the Snake River Plain Aquifer at levels that would result in unacceptable groundwater contaminant concentrations. Monitoring of soil vapor and groundwater would continue after remediation to verify that organic contaminant concentrations in the vadose zone remain below acceptable levels.

## Public Involvement Activities

**A**s soon as you receive and review this plan, you are encouraged to call any of the phone numbers listed in this plan to contact representatives of the Department of Energy, INEL regional offices, INEL Community Relations Plan office, state of Idaho, or Region 10 of the Environmental Protection Agency. You may want to ask questions, to request a briefing, or to seek additional background concerning this proposed plan.

### Public Involvement Sessions

Displays concerning progress in the INEL Environmental Restoration Program at the INEL will be set up for viewing at each of the following locations from 10 a.m. to 9 p.m. on the date listed. In Twin Falls the office session will be from 10 to 7 p.m. Project managers from the various agencies will be available to discuss concerns and issues related to this plan from 4 to 9 p.m. and in Twin Falls from 4 to 7 p.m.

Verbal comments may be given on a tape recorder at the Pocatello and Twin Falls sessions, or comments may be submitted in writing and turned in during the session or mailed in by April 30, 1994.

#### Pocatello

Tuesday, April 12  
Pine Ridge Mall  
4155 Yellowstone Avenue

#### Twin Falls

Thursday, April 14  
INEL Regional Office  
233 2nd Street North, Suite B

A public meeting will be held in conjunction with the mall sessions at the following locations. At 6:30 p.m. there will be a presentation by the agencies, followed by a question and answer session, and an opportunity to make formal public comments. **A court reporter will prepare a transcript of the public meetings, and will record public comments received.**

#### Idaho Falls

Monday, April 18  
Grand Teton Mall-  
Community Room  
2300 E. 17th Street

#### Boise

Wednesday, April 20  
Boise Centre  
on the Grove  
850 Front Street

#### Moscow

Thursday, April 21  
Palouse Empire Mall  
(former House of Fabrics Store)  
1850 W. Pullman Road

# Organic Contamination in the Vadose Zone

This postage-paid comment form is provided for your convenience in submitting written comments to DOE concerning the Organic Contamination in the Vadose Zone Proposed Plan. Please provide your name and mailing address if you would like to receive a copy of the Record of Decision and Responsiveness Summary that addresses public comments received on the Plan. Attach additional pages if necessary.

Name: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Comments: \_\_\_\_\_

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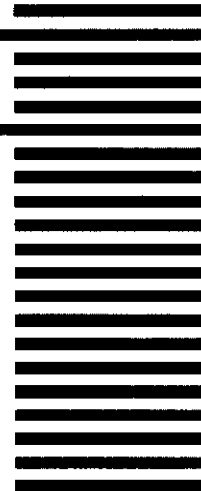
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IDAHO FALLS ID 83403-9901



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